UDC 681.5

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AUTOMATED METHODOLOGY OF CALCULATING PARAMETERS FOR HEATING MODE OF HYDRO STORAGE POWER PLANT STATION

It is necessary to use various technical improvements and non-traditional measures regarding the existing energy equipment in order to increase the ma-neuverability of the use of the existing generating capaci-ties and the possibilities of energy-efficient transfor-mation of some types of energy into others. This refers to mutual transformations of thermal and electrical energy, especially in their joint production.

The maximum thermal power of the HP, which can be obtained from the full flow of water passing through the hydro unit (3.337 GW), as well as the power of the compressor drive, which will ensure this mode (979 MW), is determined. Comparing this value with the power of the hydro unit in pumping mode (260 MW), we can conclude that it is not appropriate for the heat pump to use the energy of the entire flow of pumped water, because there is no need for such a large amount of heat, and the cost of the HP drive is 3.7 times exceed the costs of the hydraulic unit in pumping mode. That is, the meaning of this energy-saving measure is lost.

Therefore, it was decided to substantiate the marginal and rational values of thermal capacities of HP, which would improve the existing system, and not transform it into a completely different one.

The concept of the ultimate heat capacity HWS (HP) $Q_{гр}$ is proposed. This is the power at which the total consumption of conventional fuel for the hydraulic unit in pumping mode and the HP compressor will be equal to the total consumption of conventional fuel for the generator mode and the boiler unit (BU). Then, in order to calculate this maximum heat capacity, two functions of the corresponding total costs of conventional fuel were formed depending on the heat capacity of the HWS system and their combined solution was performed, which is graphically displayed (Fig. 1).

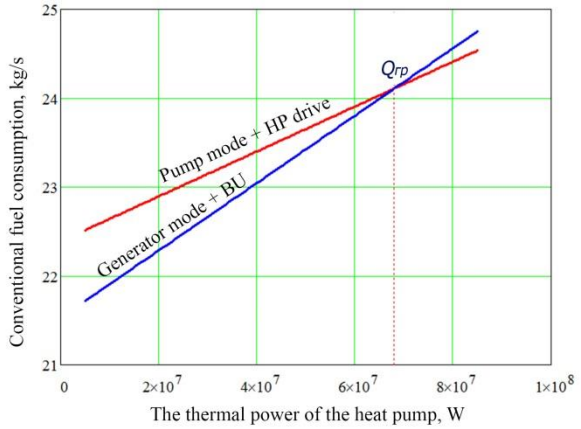

Figure 1. Determination of the maximum heat capacity of the HWS

For our case, under the described conditions and in accordance with the methodology, the maximum heat capacity of the HWS was determined, above which it is impractical to rise. It is equal to 68 MW, and the corresponding power of the HP compressor will be 20 MW, the volume of TA is 5509 m3, the number of consumers is 55094 people, the economy of conditional fuel in comparison with BU is 33%.

The concept of rational thermal power of HWS (HP) $Q_{рац}$ was introduced. This is the power at which the sum of the power of the hydraulic unit in pumping mode and the HP compressor drive will be equal to the sum of the power of the hydro unit in generator mode and the thermal power of the HP. To calculate this rational heat capacity, two functions of the corresponding total capacities were formed depending on the heat capacity of the domestic hot water system and their combined solution was performed, which is graphically displayed (Fig. 2).

For our case, under the described conditions and in accordance with the methodology, the rational heat capacity of the hot water heater, which is the most convenient to provide, was determined. It is equal to 14 MW, and the corresponding power of the TN compressor will be 4 MW, the volume of the HA is 1146 m3, the number of consumers is 11460 people, and the conventional fuel economy in comparison with the BU is 33%.

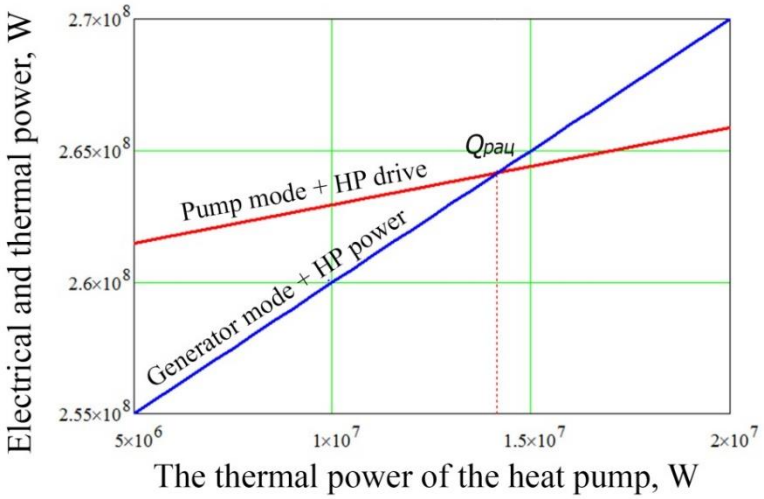

Figure 2. Determination of the rational heat capacity of the HWS

In addition to the given limit and rational modes, the automated technique allows you to calculate all the HP and HA parameters that provide the heating mode of the HSPP for arbitrary values of the thermal power of the HWS with further comparison and analysis of the investigated modes and the selection of the most promising one. The technology of using a heat pump and a heat accumulator to transfer the operation of the gas station to the heating mode (hot water supply of residential buildings) is substantiated. An automated method for determining the rational parameters of HP and HA for the implementation of the heating technology of the HSPP has been developed. The following provisions have been obtained.

1. Using the developed automated calculation method, it was analyzed and determined that the passage of the full flow of water passing through the hydraulic unit through the HP is impractical and inefficient, because the energy consumption in the HP compressor many times exceeds the consumption of the hydro unit in pumping mode, which devalues the proposed measure as energy-saving.

2. The use of a heat pump and a heat accumulator at the HSPP for hot water supply needs will save a third of conventional fuel consumption compared to a boiler unit.

3. The developed automated method allows to calculate the limit and rational values of the design and mode parameters of HP and HA, which ensure the heating mode of operation of the gas power plant to meet the needs of hot water supply.

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